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TITLE: High-Frequency-Signal Switching Circuit Suppressing High-Frequency-Signal Distortion

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HIGH-FREQUENCY-SIGNAL SWITCHING CIRCUIT SUPPRESSING HIGH-FREQUENCY-SIGNAL DISTORTION

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates to high-frequency-signal switching circuits, and more particularly, to a high-frequency-signal switching circuit which is connected to the input end of a TV-set tuner, which can be switched between when a strong electric field is input and when a weak electric field is input, and which has a reduced high-frequency-signal transfer loss and a reduced number of necessary components.

2. Description of the Related Art

There has been known a high-frequency-signal switching circuit connected to the input end of a TV-set tuner in order to handle both a strong-electric-field state and a weak-electric-field state. The high-frequency-signal switching circuit has a first high-frequency-signal path in which a high-frequency signal is transferred through a high-frequency amplifier stage, and a second high-frequency-signal path in which a high-frequency signal bypasses the high-frequency amplifier stage. In a weak-electric field state, a high-frequency signal is transferred through the first high-frequency-signal path, and is amplified by the high-frequency amplifier stage such that the high-frequency signal has a predetermined level when input to the TV-set

tuner. In a strong-electric field state, a high-frequency signal is transferred through the second high-frequency-signal path so as to bypass the high-frequency amplifier stage, so that the high-frequency signal does not exceed the predetermined level when input to the TV-set tuner.

Fig. 3 is a circuit diagram of a conventional high-frequency-signal switching circuit. A tuner in a TV set is also shown in the figure.

As shown in Fig. 3, the high-frequency-signal switching circuit 30 is formed of a first high-frequency-signal path 31, a second high-frequency-signal path 32, an input coupling circuit 33, a high-frequency-signal input terminal 34, a high-frequency-signal output terminal 35, a band decoder (switching-voltage supply section) 36, and a power-supply terminal 37.

The first high-frequency-signal path 31 is formed of an amplification field-effect transistor (FET) 31_1, a first diode 31_2, a second diode 31_3, bias-voltage setting resistors 31_4 and 31_5, a source resistor 31_6, a bypass capacitor 31_7, a load inductor 31_8, a load resistor 31_9, bypass capacitors 31_{10} and 31_{13}, DC-blocking capacitors 31_{11} and 31_{16}, and bias-voltage setting resistors 31_{12}, 31_{14}, and 31_{15}. The second high-frequency-signal path 32 is formed of a signal-transfer field-effect transistor (FET) 32_1, a third diode 32_2, DC blocking capacitors 32_3 and 32_6, and bias-voltage setting resistors 32_4 and 32_5. The input coupling circuit 33 is formed of inductors 33_1 and 33_3, and capacitors 33_2, 33_4, and

33_5.

In the first high-frequency-signal path 31, the gate of the amplification field-effect transistor 31_1 is connected to the anode of the first diode 31_2 and to one end of the bias-voltage setting resistor 31_5, the source thereof is connected to one end of the source resistor 31_6 and to one end of the bypass capacitor 31_7, and the drain thereof is connected to one end of the load inductor 31_8 and to one end of the DC-blocking capacitor 31_{11}. The cathode of the first diode 31_2 is connected to one end of the bias-voltage setting resistor 31_4 and to one end of the capacitor 33_5 in the input coupling circuit 33. The anode of the second diode 31_3 is connected to one end of the bias-voltage setting resistor 31_{14}, and the cathode thereof is connected to one end of the bias-voltage setting resistor 31_{15} and to one end of the DC-blocking capacitor 31_{16}. The other end of the bias-voltage setting resistor 31_4 is grounded, and the other end of the bias-voltage setting resistor 31_5 is connected to an output end of the band decoder 36. The other end of the source resistor 31_6 and the other end of the bypass capacitor 31_7 are grounded. The other end of the load inductor 31_8 is connected to one end of the load resistor 31_9. The other end of the load resistor 31_9 is connected to one end of the bypass capacitor 31_{10} and to the power-supply terminal 37. The other end of the bypass capacitor 31_{10} is grounded, and the other end of the DC-blocking capacitor 31_{11} is connected to the other end of the bias-voltage setting resistor 31_{12}

and to the other end of the bias-voltage setting resistor 31_{14}. The other end of the bias-voltage setting resistor 31_{12} is connected to one end of the bypass capacitor 31_{13} and to the output end of the band decoder 36. The other end of the bypass capacitor 31_{13} is grounded, and the other end of the bias-voltage setting resistor 31_{15} is grounded. The other end of the DC-blocking capacitor 31_{16} is connected to the high-frequency-signal output terminal 35.

In the second high-frequency-signal path 32, the gate of the signal-transfer field-effect transistor 32_1 is connected to the anode of the third diode 32_2 and to one end of the bias-voltage setting resistor 32_4, the source thereof is connected to one end of the bias-voltage setting resistor 32_5 and to one end of the DC-blocking capacitor 32_6, and the drain thereof is connected to one end of the DC-blocking capacitor 32_3. The cathode of the third diode 32_2 is grounded, and the other end of the DC-blocking capacitor 32_3 is connected to the cathode of the first diode 31_2. The other end of the bias-voltage setting resistor 32_4 and the other end of the bias-voltage setting resistor 32_5 are connected to the output end of the band decoder 36. The other end of the DC-blocking capacitor 32_6 is connected to the cathode of the second diode 31_3. In the input coupling circuit 33, one end of the inductor 33_1 is connected to one end of the capacitor 33_2 and to the high-frequency-signal input terminal 34, and the other end thereof is grounded. The other end of the capacitor 33_2 is connected to one end of

the inductor 33_3 and to the other end of the capacitor 33_5, the other end of the inductor 33_3 is connected to one end of the capacitor 33_4, and the other end of the capacitor 33_4 is grounded. The input end of the band decoder 36 is connected to the power-supply terminal 37, and the power-supply terminal 37 is connected to a power-supply terminal 47 of a TV-set tuner 40.

As shown in Fig. 3, the TV-set tuner 40 is formed of a VHF antenna circuit section (VHFANT) 41v, a UHF antenna circuit section (UHFANT) 41u, a VHF high-frequency amplifier section (VHFRFAMP) 42v, a UHF high-frequency amplifier section (UHFRFAMP) 42u, a VHF high-frequency circuit section (VHFRF) 43v, a UHF high-frequency circuit section (UHFRF) 43u, a VHF mixing stage (VHFMIX) 44v, a UHF mixing section (UHFMIX) 44u, an intermediate-frequency amplifier section (IFAMP) 45, an intermediate-frequency-signal output terminal 46, and the power-supply terminal 47.

In this case, the input end of the VHF antenna circuit section 41v is connected to the high-frequency-signal output terminal 35 of the high-frequency-signal switching circuit 30, and the output end thereof is connected to the input end of the VHF high-frequency amplifier section 42v. The input end of the UHF antenna circuit section 41u is connected to the high-frequency-signal output terminal 35, and the output end thereof is connected to the input end of the UHF high-frequency amplifier section 42u. The output end of the VHF high-frequency amplifier section 42v is connected to the

input end of the VHF high-frequency circuit section 43v, and the output end of the UHF high-frequency amplifier section 42u is connected to the input end of the UHF high-frequency circuit section 43u. The output end of the VHF high-frequency circuit section 43v is connected to the input end of the VHF mixing stage 44v, and the output end of the UHF high-frequency circuit section 43u is connected to the input end of the UHF mixing stage 44u. The output end of the VHF mixing stage 44v is connected to the input end of the intermediate-frequency amplifier section 45, and the output end of the UHF mixing stage 44u is connected to the input end of the intermediate-frequency amplifier section 45. The output end of the intermediate-frequency amplifier section 45 is connected to the intermediate-frequency-signal output terminal 46.

The high-frequency-signal switching circuit 30 having the above structure operates in the following way.

When the TV-set tuner 40 connected to the high-frequency-signal switching circuit 30 is used in a weak-electric-field area, namely, an area where the field intensity of received signals is low, the band decoder 36 in the high-frequency-signal switching circuit 30 is switched to output a voltage V_B, such as 5 V, equal to a power-supply voltage from its output end. Then, the voltage V_B output from the band decoder 36 is sent to the gate of the amplification field-effect transistor 31_1 through the bias-voltage setting resistor 31_5 to make the amplification field-

effect transistor 31_1 be in an operation state. At the same time, current caused by the voltage V_B flows through the bias-voltage setting resistor 31_5, the first diode 31_2, and the bias-voltage setting resistor 31_4 into the ground to turn on the first diode 31_2. Current caused by the voltage V_B also flows through the bias-voltage setting resistors 31_{12} and 31_{14}, the second diode 31_3, and the bias-voltage setting resistor 31_{15} into the ground to turn on the second diode 31_3. Current caused by the voltage V_B also flows through the bias-voltage setting resistor 32_4 and the third diode 32_2 to make the gate voltage of the signal-transfer field-effect transistor 32_1 lower than the source voltage thereof to turn off the signal-transfer field-effect transistor 32_1.

Therefore, whereas the first high-frequency-signal path 31 is active, the second high-frequency-signal path 32 is inactive. A low-level high-frequency signal input to the high-frequency-signal input terminal 34 is sent through the first diode 31_2, which is on, to the amplification field-effect transistor 31_1, is amplified to a predetermined level by the amplification field-effect transistor 31_1, and then, is sent through the second diode 31_3, which is on, to the high-frequency-signal output terminal 35. At this point of time, since the signal-transfer field-effect transistor 32_1 is off, the high-frequency signal is not sent through the signal-transfer field-effect transistor 32_1 to the high-frequency-signal output terminal 35.

When the TV-set tuner 40 connected to the high-

frequency-signal switching circuit 30 is used in a strong-electric-field area, namely, an area where the field intensity of received signals is high, the band decoder 36 in the high-frequency-signal switching circuit 30 is switched to output a voltage V_E, such as 0 V, equal to a ground voltage from its output end. Then, even when the ground voltage V_E output from the band decoder 36 is sent to the gate of the amplification field-effect transistor 31_1 through the bias-voltage setting resistor 31_5, it cannot make the amplification field-effect transistor 31_1 be in an operation state. The amplification field-effect transistor 31_1 is in an non-operation state. At the same time, current does not flow through the bias-voltage setting resistor 31_5, the first diode 31_2, and the bias-voltage setting resistor 31_4 into the ground, by the ground voltage V_E, so that the first diode 31_2 is turned off. In the same way, current does not flow through the bias-voltage setting resistors 31_{12} and 31_{14}, the second diode 31_3, and the bias-voltage setting resistor 31_{15} into the ground, by the ground voltage V_E, so that the second diode 31_3 is also turned off. Current does not flow through the bias-voltage setting resistors 32_4 and the third diode 32_2, by the ground voltage V_E, so that the voltage difference between the gate and the source of the signal-transfer field-effect transistor 32_1 becomes zero to turn on the signal-transfer field-effect transistor 32_1.

Therefore, whereas the first high-frequency-signal path 31 is inactive, the second high-frequency-signal path 32 is

active. A high-level high-frequency signal input to the high-frequency-signal input terminal 34 is sent through the signal-transfer field-effect transistor 32_1, which is on, to the high-frequency-signal output terminal 35. At this point of time, since the first diode 31_2 and the second diode 31_3 are both off, and the amplification field-effect transistor 31_1 is inactive, the high-frequency signal is not sent through the amplification field-effect transistor 31_1 to the high-frequency-signal output terminal 35.

Then, the high-frequency signal sent to the high-frequency-signal output terminal 35 is sent to the TV-set tuner. If the high-frequency signal is a received VHF-band TV signal, signal components in unnecessary signal-frequency bands are removed from the received TV signal by the VHF antenna circuit section 41v, the resultant signal is amplified to a predetermined level by the VHF high-frequency amplifier section 42v, signal components in unnecessary signal-frequency bands are again removed from the amplified signal by the VHF high-frequency circuit section 43v, the resultant signal is converted to an intermediate-frequency signal by the VHF mixing stage 44v, the obtained intermediate-frequency signal is amplified to a predetermined level by the intermediate-frequency amplifier section 45, and the amplified signal is sent to the intermediate-frequency-signal output terminal 46. If the high-frequency signal is a received UHF-band TV signal, signal components in unnecessary signal-frequency bands are

removed from the received TV signal by the UHF antenna circuit section 41u, the resultant signal is amplified to a predetermined level by the UHF high-frequency amplifier section 42u, signal components in unnecessary signal-frequency bands are again removed from the amplified signal by the UHF high-frequency circuit section 43u, the resultant signal is converted to an intermediate-frequency signal by the UHF mixing stage 44u, the obtained intermediate-frequency signal is amplified to a predetermined level by the intermediate-frequency amplifier section 45, and the amplified signal is sent to the intermediate-frequency-signal output terminal 46.

In the known high-frequency-signal switching circuit 30, when the first high-frequency-signal path 31 becomes inactive and at the same time, the second high-frequency-signal path 32 becomes active, a high-frequency signal is transferred in the second high-frequency-signal path 32 through the signal-transfer field-effect transistor 32_1, which is on. Therefore, a signal transfer loss, for example, of about 3 dB to 4 dB occurs due to the signal-transfer field-effect transistor 32_1. In addition, since relatively expensive circuit components, such as the high-frequency field-effect transistor 32_1, are required to make the second high-frequency-signal path 32, the manufacturing cost of the high-frequency-signal switching circuit 30 becomes high.

In the known high-frequency-signal switching circuit 30, when the first high-frequency-signal path 31 is inactive, an

off bias voltage which makes the first diode 31_2 and the second diode 31_3 off is relatively shallow. Therefore, when a high-level high-frequency signal is sent, a part of the high-level high-frequency signal flows into the first diode 31_2 and the second diode 31_3, the high-frequency signal which is transferred through the second high-frequency-signal path 32 may be distorted.

SUMMARY OF THE INVENTION

The present invention has been made in consideration of such a technical background. Accordingly, it is an object of the present invention to provide a high-frequency-signal switching circuit which reduces a signal transfer loss in a weak-electric-field state and relatively expensive circuit components and which makes the off bias value of a diode deep to suppress a distortion in a high-frequency signal.

The foregoing object is achieved by the present invention through the provision of a high-frequency-signal switching circuit including: a first high-frequency-signal path including a high-frequency amplifier stage, a first diode connected in series between a high-frequency-signal input end and the input end of the high-frequency amplifier stage, and a second diode connected in series between a high-frequency-signal output end and the output end of the high-frequency amplifier stage; a second high-frequency-signal path comprising a third diode connected in series between the high-frequency-signal input end and the high-

frequency-signal output end; and a switching-voltage supply section for switching the high-frequency amplifier stage between an operation state and an non-operation state, and for switching the first to third diodes between an ON state and an OFF state, wherein, when the switching voltage of the switching-voltage supply section has a first value, the high-frequency amplifier stage is in the operation state, the first and second diodes are in the ON state, and the third diode is in the OFF state, so that a high-frequency signal is transferred through the first high-frequency-signal path, and when the switching voltage of the switching-voltage supply section has a second value, the high-frequency amplifier stage is in the non-operation state, the first and second diodes are in the OFF state, and the third diode is in the ON state, so that a high-frequency signal is transferred through the second high-frequency-signal path.

Since the second high-frequency-signal path is formed of the third diode, which is on or off, a signal transfer loss can be largely reduced when the third diode is on. In addition, only the third diode is used to constitute the second high-frequency-signal path, the number of components is reduced. Furthermore, since a reverse bias voltage which sufficiently turns off the first diode and the second diode in the first high-frequency-signal path is generated when a forward bias voltage which turns on the third diode is generated, it does not occur that a part of a high-level

high-frequency signal flows into the first diode and the second diode when the diodes are off to distort the high-frequency signal being transferred.

The high-frequency-signal switching circuit may be configured such that the anode of each of the first and second diodes is connected to the switching-voltage supply section through a resistor, and the cathode thereof is connected to a reference potential point through a resistor. The high-frequency-signal switching circuit may be further configured such that the resistance of each resistor is specified such that, when the switching voltage has the first value, the cathode voltage of the first diode is lower than that of the second diode, and when the switching voltage has the second value, the cathode voltage of the first diode is higher than that of the second diode.

With such a configuration, it is easy to specify a forward bias voltage which turns on the first diode and the second diode, and a reverse bias voltage which turns off the first diode and the second diode. In addition, it is also easy to specify a reverse bias voltage which turns off the third diode, and a forward bias voltage which turns on the third diode.

BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 is a circuit diagram of a high-frequency-signal switching circuit according to an embodiment of the present invention, with a TV-set tuner being shown together.

Fig. 2A and Fig. 2B are equivalent circuit diagrams showing a main part which is operating, of the high-frequency-signal switching circuit shown in Fig. 1.

Fig. 3 is a circuit diagram of a known high-frequency-signal switching circuit with a TV-set tuner being shown together.

DESCRIPTION OF THE PREFERRED EMBODIMENT

An embodiment of the present invention will be described below by referring to the drawings.

Fig. 1 is a circuit diagram of a high-frequency-signal switching circuit according to an embodiment of the present invention. A tuner in a TV set is also shown in the figure.

As shown in Fig. 1, the high-frequency-signal switching circuit 1 is formed of a first high-frequency-signal path 2, a second high-frequency-signal path 3, an input coupling circuit 4, a high-frequency-signal input terminal 5, a high-frequency-signal output terminal 6, a power-supply terminal 7, and a band decoder (switching-voltage supply section) 8.

The first high-frequency-signal path 2 is formed of an amplification field-effect transistor (FET) 2_1, a first diode 2_2, a second diode 2_3, bias-voltage setting resistors 2_4, 2_5, and 2_6, a source resistor 2_7, a bypass capacitor 2_8, a load inductor 2_9, a load resistor 2_{10}, bypass capacitors 2_{11} and 2_{15}, a DC-blocking capacitors 2_{12} and 2_{17}, and bias-voltage setting resistors 2_{13}, 2_{14}, and 2_{16}. The second high-frequency-signal path 3 is formed of a third diode 3_1. The input coupling

circuit 4 is formed of inductors 4_1 and 4_3, and capacitors 4_2, 4_4, and 4_5. In this case, a circuit which includes the amplification field-effect transistor 2_1 constitutes a linear high-frequency amplifier stage.

In the first high-frequency-signal path 2, the gate of the amplification field-effect transistor 2_1 is connected to the anode of the first diode 2_2 and to one end of the bias-voltage setting resistor 2_5, the source thereof is connected to one end of the source resistor 2_7 and to one end of the bypass capacitor 2_8, and the drain thereof is connected to one end of the load inductor 2_9 and to one end of the DC-blocking capacitor 2_{12}. The cathode of the first diode 2_2 is connected to one end of the bias-voltage setting resistor 2_4 and to one end of the capacitor 4_5 in the input coupling circuit 4. The anode of the second diode 2_3 is connected to one end of the bias-voltage setting resistor 2_{14}, and the cathode thereof is connected to one end of the bias-voltage setting resistor 2_{16} and to one end of the DC-blocking capacitor 2_{17}. The other end of the bias-voltage setting resistor 2_4 is grounded, and the other end of the bias-voltage setting resistor 2_5 is connected to an output end of the band decoder 8. The other end of the bias-voltage setting resistor 2_6 is connected to the power-supply terminal 7. The other end of the source resistor 2_7 and the other end of the bypass capacitor 2_8 are grounded. The other end of the load inductor 2_9 is connected to one end of the load resistor 2_{10}. The other end of the load resistor 2_{10} is

connected to one end of the bypass capacitor 2_{11} and to the power-supply terminal 7. The other end of the bypass capacitor 2_{11} is grounded, and the other end of the DC-blocking capacitor 2_{12} is connected to one end of the bias-voltage setting resistor 2_{13} and to the other end of the bias-voltage setting resistor 2_{14}. The other end of the bias-voltage setting resistor 2_{13} is connected to one end of the bypass capacitor 2_{15} and to the output end of the band decoder 8. The other end of the bypass capacitor 2_{15} is grounded, and the other end of the bias-voltage setting resistor 2_{16} is grounded. The other end of the DC-blocking capacitor 2_{17} is connected to the high-frequency-signal output terminal 6.

In the second high-frequency-signal path 3, the anode of the third diode 3_1 is connected to the cathode of the first diode 2_2, and the cathode thereof is connected to the cathode of the second diode 2_3. In the input coupling circuit 4, one end of the inductor 4_1 is connected to one end of the capacitor 4_2 and to the high-frequency-signal input terminal 5, and the other end thereof is grounded. The other end of the capacitor 4_2 is connected to one end of the inductor 4_3 and to the other end of the capacitor 4_5, the other end of the inductor 4_3 is connected to one end of the capacitor 4_4, and the other end of the capacitor 4_4 is grounded. The power-supply terminal 7 is connected to a power-supply terminal 16 of a TV-set tuner 9, and the input end of the band decoder 8 is connected to the power-supply

terminal 7.

As shown in Fig. 1, the TV-set tuner 9 has the same structure as the TV-set tuner 40 shown in Fig. 3, and is formed of a VHF antenna circuit section (VHFANT) 10v, a UHF antenna circuit section (UHFANT) 10u, a VHF high-frequency amplifier section (VHFRFAMP) 11v, a UHF high-frequency amplifier section (UHFRFAMP) 11u, a VHF high-frequency circuit section (VHFRF) 12v, a UHF high-frequency circuit section (UHFRF) 12u, a VHF mixing stage (VHFMIX) 13v, a UHF mixing section (UHFMIX) 13u, an intermediate-frequency amplifier section (IFAMP) 14, an intermediate-frequency-signal output terminal 15, and the power-supply terminal 16.

In this case, the input end of the VHF antenna circuit section 10v is connected to the high-frequency-signal output terminal 6, and the output end thereof is connected to the input end of the VHF high-frequency amplifier section 11v. The input end of the UHF antenna circuit section 10u is connected to the high-frequency-signal output terminal 6, and the output end thereof is connected to the input end of the UHF high-frequency amplifier section 11u. The output end of the VHF high-frequency amplifier section 11v is connected to the input end of the VHF high-frequency circuit section 12v, and the output end of the UHF high-frequency amplifier section 11u is connected to the input end of the UHF high-frequency circuit section 12u. The output end of the VHF high-frequency circuit section 12v is connected to the input end of the VHF mixing stage 13v, and the output

end of the UHF high-frequency circuit section 12u is connected to the input end of the UHF mixing stage 13u. The output end of the VHF mixing stage 13v is connected to the input end of the intermediate-frequency amplifier section 14, and the output end of the UHF mixing stage 13u is connected to the input end of the intermediate-frequency amplifier section 14. The output end of the intermediate-frequency amplifier section 14 is connected to the intermediate-frequency-signal output terminal 15.

Fig. 2A and Fig. 2B are equivalent circuit diagrams of a main section which is operating, of the high-frequency-signal switching circuit 1 shown in Fig. 1. Fig. 2A shows a state in which the first high-frequency-signal path 2 is operating and the second high-frequency-signal path 3 is not operating. Fig. 2B shows a state in which the first high-frequency-signal path 2 is not operating and the second high-frequency-signal path 3 is operating.

In Fig. 2A and Fig. 2B, there are shown a high-frequency amplifier stage 17_1 which includes the amplification field-effect transistor 2_1, a first switch 17_2 formed of the first diode 2_2, a second switch 17_3 formed of the second diode 2_3, and a third switch 17_4 formed of the third diode 3_1. The same symbols as those used in Fig. 1 are assigned to the same components as those shown in Fig. 1.

The operation of the high-frequency-signal switching circuit 1 according to the present embodiment will be described below by referring to Fig. 2A and Fig. 2B.

Also in the present embodiment, when the TV-set tuner 9 connected to the high-frequency-signal switching circuit 1 is used in a weak-electric-field area, namely, an area where the field intensity of received signals is low, the band decoder 8 in the high-frequency-signal switching circuit 1 is switched to output a voltage V_B, such as 5 V, equal to a power-supply voltage from its output end. Then, the voltage V_B output from the band decoder 8 is sent to the gate of the amplification field-effect transistor 2_1 through the bias-voltage setting resistor 2_5 to make the amplification field-effect transistor 2_1 be in an operation state. At the same time, current caused by the voltage V_B flows through the bias-voltage setting resistor 2_5, the first diode 2_2, and the bias-voltage setting resistor 2_4 into the ground to turn on the first diode 2_2. Current caused by the voltage V_B also flows through the two bias-voltage setting resistor 2_{13} and 2_{14}, the second diode 2_3, and the bias-voltage setting resistor 2_{16} into the ground to turn on the second diode 2_3. In this state, when the resistances of the bias-voltage setting resistors 2_4, 2_5, 2_{13}, 2_{14}, and 2_{16} are specified such that, if the power-supply voltage is 5 V, the anode voltage of the third diode 3_1, namely, a voltage at a point A shown in Fig. 1, Fig. 2A, and Fig. 2B, is 2.5 V, and the cathode voltage of the third diode 3_1, namely, a voltage at a point B shown in Fig. 1, Fig. 2A, and Fig. 2B, is 4.6 V, the voltage V_B is applied to the third diode 3_1 through the bias-voltage setting resistor 2_6 as a reverse bias voltage to turn off the

third diode 3_1. The state of the high-frequency-signal switching circuit 1, obtained at this point of time is shown in Fig. 2A.

Therefore, whereas the first high-frequency-signal path 2 is active, the second high-frequency-signal path 3 is inactive. A low-level high-frequency signal input to the high-frequency-signal input terminal 5 is sent through the first diode 2_2, which is on, to the amplification field-effect transistor 2_1, which is in an operation state, is amplified to a predetermined level by the amplification field-effect transistor 2_1, and then, is sent through the second diode 2_3, which is on, to the high-frequency-signal output terminal 6. On the other hand, since the third diode 3_1 is off, the high-frequency signal is not sent through the third diode 3_1 to the high-frequency-signal output terminal 6.

When the TV-set tuner 9 connected to the high-frequency-signal switching circuit 1 is used in a strong-electric-field area, namely, an area where the field intensity of received signals is high, the band decoder 8 in the high-frequency-signal switching circuit 1 is switched to output a voltage V_E, such as 0 V, equal to a ground voltage from its output end. Then, even when the ground voltage V_E output from the band decoder 8 is sent to the gate of the amplification field-effect transistor 2_1 through the bias-voltage setting resistor 2_5, it cannot make the amplification field-effect transistor 2_1 be in an operation state. The amplification field-effect transistor 2_1 is in an non-

operation state. At the same time, current does not flow through the bias-voltage setting resistor 2_5, the first diode 2_2, and the bias-voltage setting resistor 2_4 into the ground, by the ground voltage V_E, so that the first diode 2_2 is turned off. In the same way, current does not flow through the two bias-voltage setting resistor 2_{13} and 2_{14}, the second diode 2_3, and the bias-voltage setting resistor 2_{16} into the ground, by the ground voltage V_E, so that the second diode 2_3 is also turned off. In this state, a bias voltage is applied from the power-supply terminal 7 through the bias-voltage setting resistor 2_6 to the cathode of the second diode 2_2 and to the anode of the third diode 3_1, a voltage at the point A shown in Fig. 1, Fig. 2A, and Fig. 2B becomes 1.6 V, and the cathode voltage of the third diode 3_1, namely, a voltage at the point B shown in Fig. 1, Fig. 2A, and Fig. 2B, becomes 0.9 V. A forward bias voltage is applied to the third diode 3_1 to turn on the third diode 3_1. Reverse bias voltages are positively applied to the first diode 2_2 and to the second diode 2_3 as the third diode 3_1 is turned on, and the reverse bias voltage applied to the first diode 2_2 is high. The state of the high-frequency-signal switching circuit 1, obtained at this point of time is shown in Fig. 2B.

Therefore, whereas the first high-frequency-signal path 2 is inactive, the second high-frequency-signal path 3 is active. A high-level high-frequency signal input to the high-frequency-signal input terminal 5 is sent through the

third diode 3_1, which is on, to the high-frequency-signal output terminal 6. At this point of time, since the first diode 2_2 and the second diode 2_3 are both off, and the amplification field-effect transistor 2_1 is inactive, the high-frequency signal is not sent through the amplification field-effect transistor 2_1 to the high-frequency-signal output terminal 6. In addition, since the reverse bias voltage applied to the first diode 2_2 is relatively deep, the high-level high-frequency signal does not flow into the first diode 2_2 or into the second diode 2_3. Therefore, the high-frequency signal sent through the second high-frequency-signal path 3 is not distorted.

Then, the high-frequency signal sent through the high-frequency-signal switching circuit 1 is sent to the TV-set tuner 9 connected to the high-frequency-signal output terminal 6. Also in this case, if the high-frequency signal is a received VHF-band TV signal, signal components in unnecessary signal-frequency bands are removed from the received TV signal by the VHF antenna circuit section 10v, the resultant signal is amplified to a predetermined level by the VHF high-frequency amplifier section 11v, signal components in unnecessary signal-frequency bands are again removed from the amplified signal by the VHF high-frequency circuit section 12v, the resultant signal is converted to an intermediate-frequency signal by the VHF mixing stage 13v, the obtained intermediate-frequency signal is amplified to a predetermined level by the intermediate-frequency amplifier

section 14, and the amplified signal is sent to the intermediate-frequency-signal output terminal 15. If the high-frequency signal is a received UHF-band TV signal, signal components in unnecessary signal-frequency bands are removed from the received TV signal by the UHF antenna circuit section 10u, the resultant signal is amplified to a predetermined level by the UHF high-frequency amplifier section 11u, signal components in unnecessary signal-frequency bands are again removed from the amplified signal by the UHF high-frequency circuit section 12u, the resultant signal is converted to an intermediate-frequency signal by the UHF mixing stage 13u, the obtained intermediate-frequency signal is amplified to a predetermined level by the intermediate-frequency amplifier section 14, and the amplified signal is sent to the intermediate-frequency-signal output terminal 15.

Although the voltage of each portion in the high-frequency-signal switching circuit 1 according to the present embodiment indicates an appropriate voltage used in reduction to practice, the high-frequency-signal switching circuit 1 according to the present invention is not limited to that having such voltages. It is needless to say that such voltages can be appropriately changed within the scope of the technical contents of the present invention.

Note that the diodes are not necessarily limited to semiconductor diodes: they may be any type of switch that is electronically controllable. In addition, the diodes may be

of any type known in the art including p-n diodes, Schottky diodes or Josephson junctions, for example. Similarly, the amplifier may be any amplifier known in the art including bipolar junction transistors, for example.